

Ex. #550

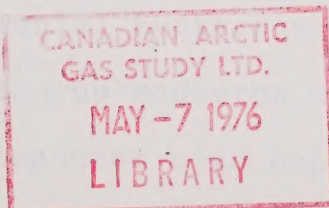
Mackenzie Valley Pipeline Inquiry

THE MIZUSHIMA OIL SPILL

Evidence presented on behalf of C.O.P.E.

C.W. Nicol
Environment Protection Service
April 1976

MACKENZIE VALLEY PIPELINE INQUIRY
EXHIBIT NO. 550 A E April 7/76
Yellowknife out.
C.O.P.E.



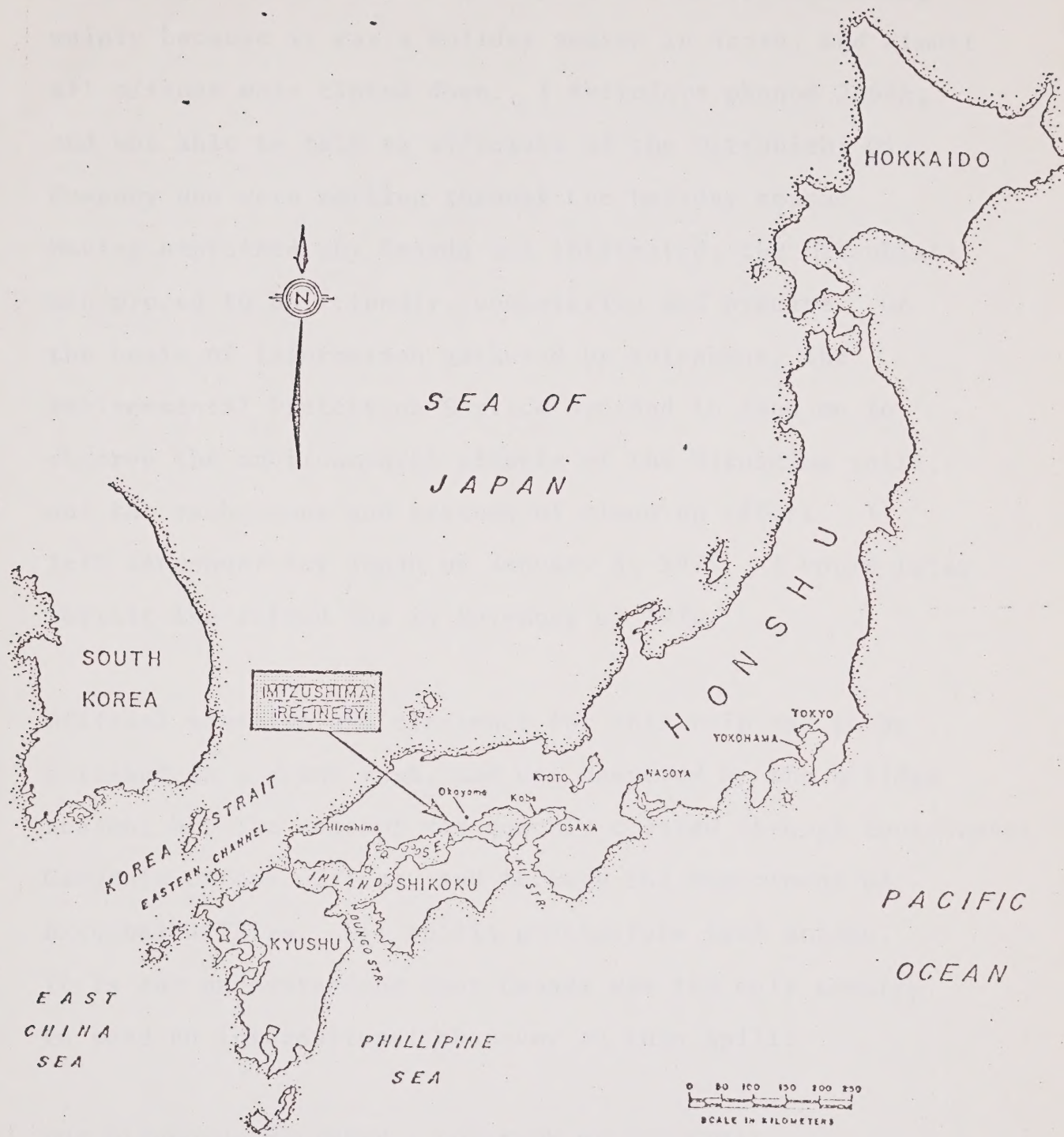
During the last week of December 1974, the Canadian press carried small articles about an oil spill of dramatic proportions into the Inland Sea of Japan. The Inland Sea, or Seto Naikai, is a body of water hemmed by the main islands of Honshu, Shikoku and Kyushu.

It opens into the Phillipine Sea through the Bungo Straits and Kii Straits, and into the Japan Sea through the narrower Kanmon Straits.

The coastline is extremely rugged and mountainous, forested with pine and bamboo and with groves of the finest oranges. The Inland Sea is dotted with hundreds of rocky islands, the greater part being a national park.

There are similarities between the Inland Sea of Japan and the Georgia Strait, Gulf Islands and Puget Sound areas of Canada and the United States, despite the difference in latitude (the Inland Sea being about 15 degrees further south). Both have Pacific waters and Pacific fauna and flora. Both have rugged coastlines and scenic islands. Both have fast currents and tidal rips. Both are subject to storms, and have similar mixing patterns, and both are rich in fisheries.

Because of these similarities, the Environmental Protection Service, Vancouver, felt a keen sympathy and interest in the Mizushima spill. On December 30, 1974, a senior technician with the Environmental Emergency Branch, was asked to find out what clean-up measures were being taken, and how long the countermeasures were expected to take. Prior to that time I had spent four and a half years in Japan, and



LOCATION OF THE MIZUSHIMA REFINERY
IN THE INLAND SEA OF JAPAN

Figure 1



Digitized by the Internet Archive
in 2025 with funding from
University of Toronto

<https://archive.org/details/31761120643911>

- 2 -

had studied for a year in a Japanese fisheries college. In late December of 1974, I found it impossible to obtain accurate information through Japanese sources in Canada, mainly because it was a holiday season in Japan, and almost all offices were closed down. I therefore phoned Japan, and was able to talk to officials of the Mitsubishi Oil Company who were working through the holiday season. Having explained why Canada was interested, the Mitsubishi men proved to be friendly, cooperative and precise. On the basis of information gathered by telephone, the Environmental Protection Service decided to send me to observe the environmental effects of the Mizushima spill, and the techniques and systems of clean-up effort. I left Vancouver for Japan on January 5, 1975. I would later revisit the Inland Sea in November of 1975.

Official sanction and clearance for this trip had to be obtained in a great rush, and was hampered by the holiday season, but the concept was quickly cleared through Environment Canada's Ottawa offices, and through the Department of External Affairs. Oil spills precipitate fast action. It is our understanding that Canada was the only country to send an international observer on this spill.

THE MIZUSHIMA REFINERY - LOCATION OF THE SPILL

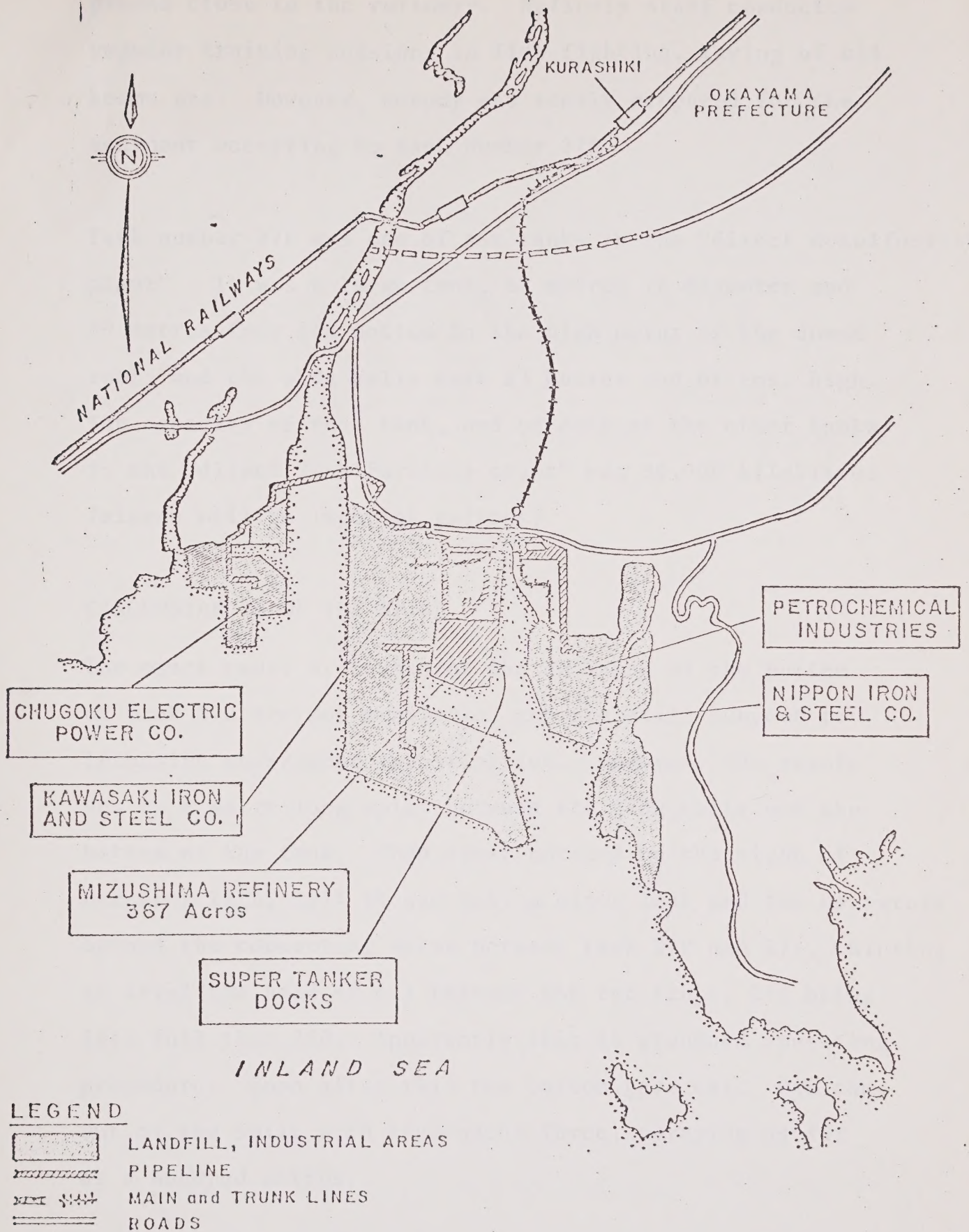
The Mitsubishi refinery in Mizushima occupies about 367 acres of landfill edging into the Inland Sea from the Honshu coastline. It is in the prefecture of Okayama, roughly four hundred miles from Tokyo, and lying between

the giant port of Kobe and the ship building yards of Kure.

Completed in 1961, the Mizushima refinery is one of the most modern in Japan. It has a crude oil processing capacity of 270,000 barrels per day and produces fuels (gasoline, diesel, kerosene, fuel oil etc.), lubricating oils, and aromatics. It is the largest aromatic centre in Japan. At its deep water crude oil pier, ocean tankers can offload at a rate of 50,000 barrels an hour through a 77 cm. pipeline into one of the largest crude tanks in the world which has a capacity of 735,000 barrels. In total, the refinery has seventeen crude oil tanks, with a total capacity of 10,377,000 barrels.

About 65 percent of the refinery's oil products are shipped by coastal tankers and barges. Thirty percent of the products are conducted by pipelines directly to Mitsubishi Chemical Company, Mitsubishi Gas Chemical Company, Kawasaki Iron and Steel Company, Chugoku Electric Power Company and other industries in the area. The remaining products are shipped by tank cars and trucks.

The management of the refinery have been very sensitive in the past to public opinion and the growing insistence in Japan for anti-pollution measures. Mr. Ogawa, Chief of the Water Pollution Control Board, a Japanese government agency, based in Tokyo, told me most emphatically that government and industry had been working towards cleaning up pollution problems in the Inland Sea for twenty years, and that it had recently been possible to fish for marketable



MIZUSHIMA

THE OIL REFINERY AND ASSOCIATED INDUSTRIES

Figure 2

prawns close to the refinery. Refinery staff conducted regular training sessions in fire-fighting, laying of oil booms etc. However, nobody was really prepared for the accident occurring to tank number 270.

Tank number 270 was one of six tanks in the "direct desulfurizing plant". It was a large tank, 52 metres in diameter and 30 metres from its bottom to the high point of the domed roof, and the side walls were 23 metres and 67 cms. high. The capacity of this tank, and of each of the other tanks in the "direct desulfurizing plant" was 50,000 kilolitres (eleven million Imperial gallons).

CIRCUMSTANCES OF THE SPILL

The exact cause or causes of the collapse of the bottom of tank 270 are not available, and are still subject to intensive government investigation. However, the result was an 8 metre long split between the side walls and the bottom of the tank. When first noticed on the night of December 18th, 1974 it was only a minor leak and the operators opened the connecting valve between tank 270 and 271, thinking to level the head of oil between the two tanks, 271 being less full than 270. Apparently this is standard operating procedure. Soon after this the bottom gave way. Oil came out of the split with tremendous force, spraying as far as a hundred metres.

The escaping oil was at temperatures between 80 and 90 degrees C., which made it virtually impossible for men to stop the flood. It was some time before men could get

to the valves connecting 270 and 271 to shut them off.

By this time, most of the oil was gone, and the huge tank buckled and split like an old paper bag.

Figures given out by the refinery state that the amount of oil lost from tanks 270 and 271 was 42,888 kilolitres.

(9,434,309.2 gallons Imp.) According to the official Japanese government report (General Investigation into the Environmental influences of the Mizushima Oil Spill of 1974) only 7,500 to 9,500 kilolitres (1,649,816 to 2,089,767 Imp. Gallons) was presumed to have escaped from the land to the sea. (It must be stated however, that these figures were held in doubt by the Japanese press. Also find it strange that this relatively small amount would cause such a vast pollution.)

The tank area was enclosed by somewhat fragile concrete retaining wall, but when the oil rushed out it displaced the concrete and steel base of the tank's stairway, and this base, weighing 34 tons, smashed through the retaining wall. The stairway was of the vertical type.

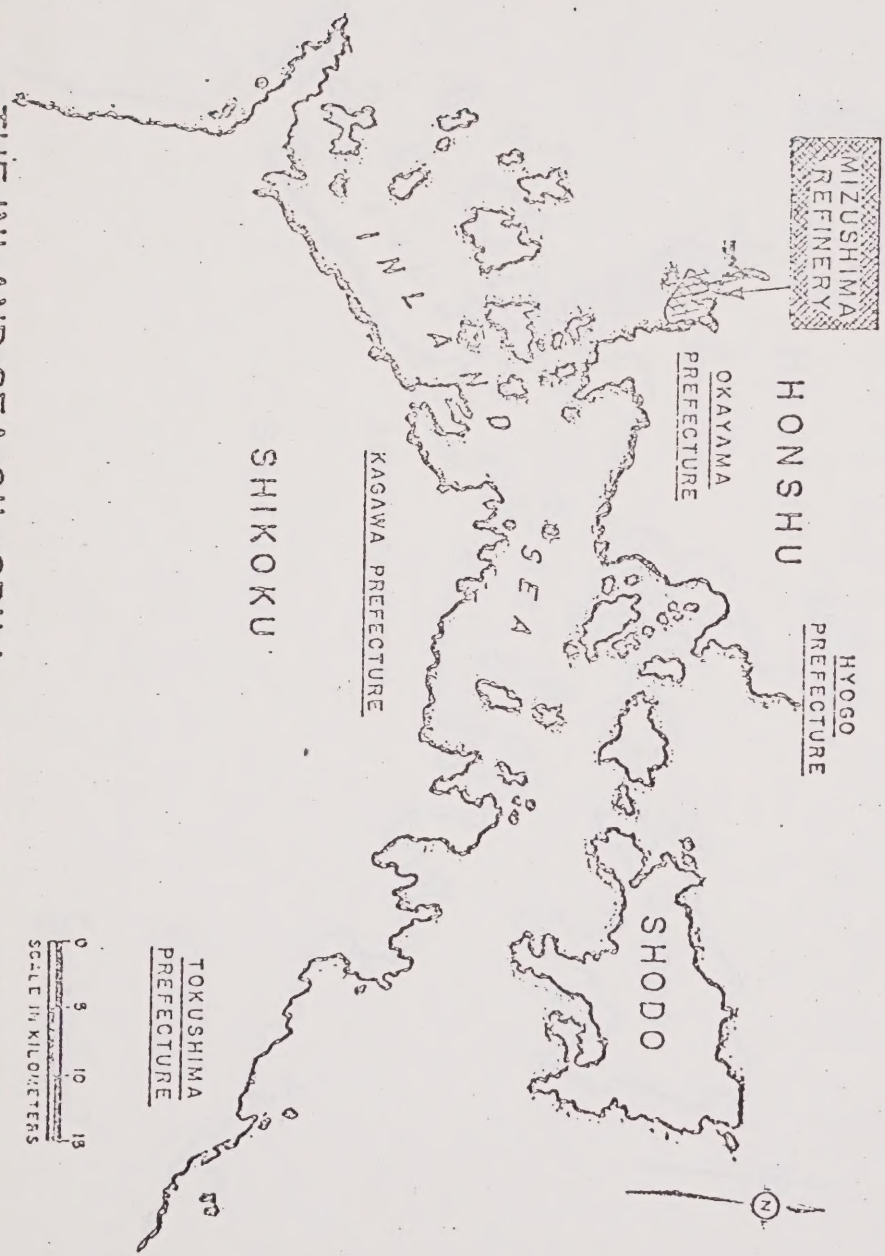
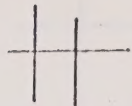
The escaped oil flowed along refinery roads for a few hundred yards and entered a canal which let to an oil separator. The oil flowed over the separator and into the artificial harbour of the Mizushima Industrial Area.

The volume and temperature of the escaping oil made it difficult if not impossible to contain on land or in the canal (at least, this is what refinery officials claimed on site in January 1975), and once into the harbour,

strong winds, waves, and darkness made efforts at containment futile. Booms were placed, and the Maritime Safety Agency contacted. Nobody was really prepared for this accident, and when it happened, the most immediate and pressing fear was that of fire.

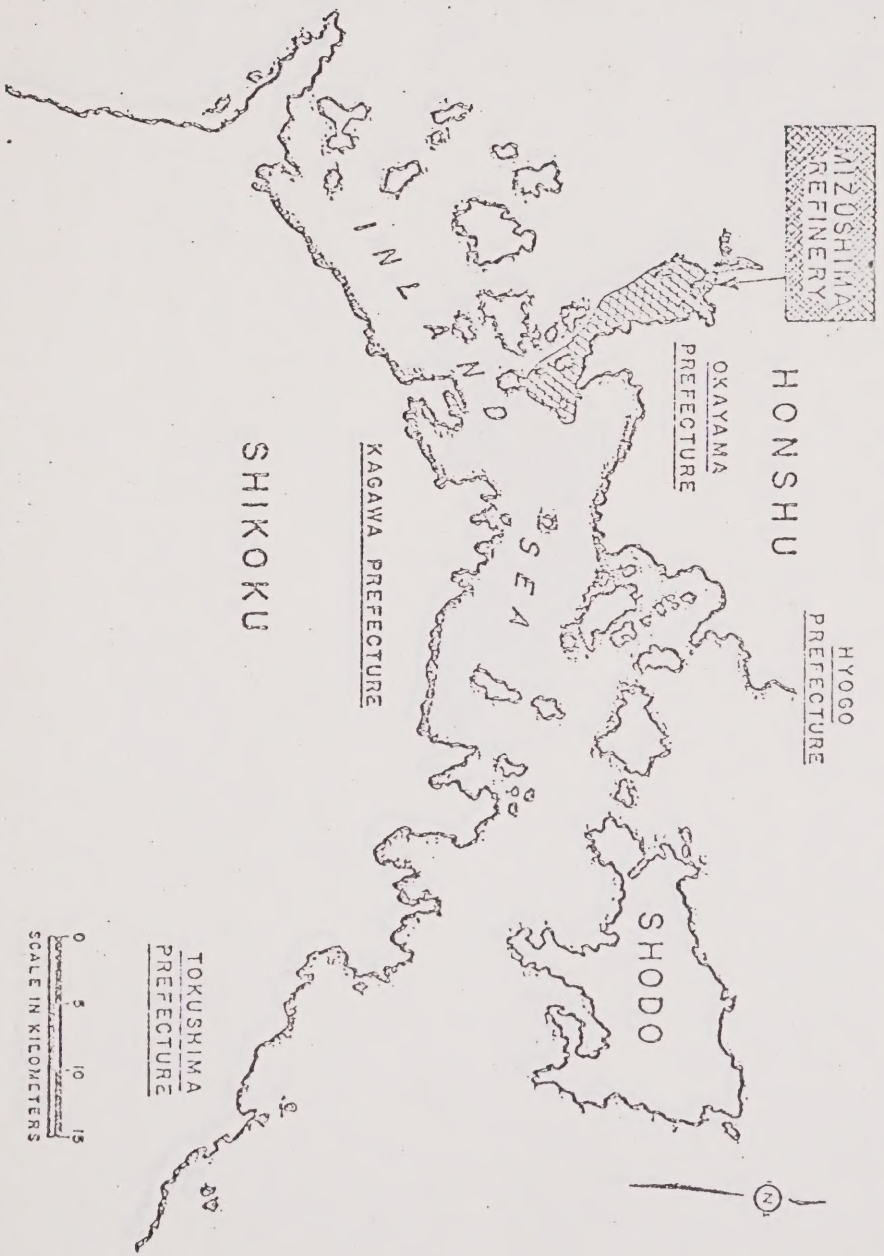
The Maritime Safety Agency mobilized 41 patrol vessels and tried to emulsify the oil with dispersants. In retrospect, it is easy to understand why this effort would fail: firstly, the sheer volume of oil to be dispersed would mean a very large stockpile of chemical dispersants, plus the ability to spray and mix this amount in a short period of time: secondly, the temperature of the sea was low enough to make the heavy Bunker C 'tacky' and difficult to emulsify: thirdly, the oil was moving.

The head of the No. 1 Shimotsui Fishery Cooperative, Mr. Katsumi Koyama, is reported to have telephoned the Maritime Safety Agency at 0600 hours on the morning of December 19, when most of the oil was still inside the port of Mizushima. He offered help to the office, but help was refused by the agency, which claimed that they could better handle it themselves. Seven representatives of the fishery cooperative visited the agency in the afternoon of December 19, and again offered help, but again were turned down. Finally, after consultation with the prefectural governments, help was requested, and on the morning of December 20, 75 fishing boats set sail to join the clean-up effort, but by this time the oil slicks had escaped far into the Inland Sea, carried by strong north westerly winds and by the swift tidal currents. (Figures 3 - 9)



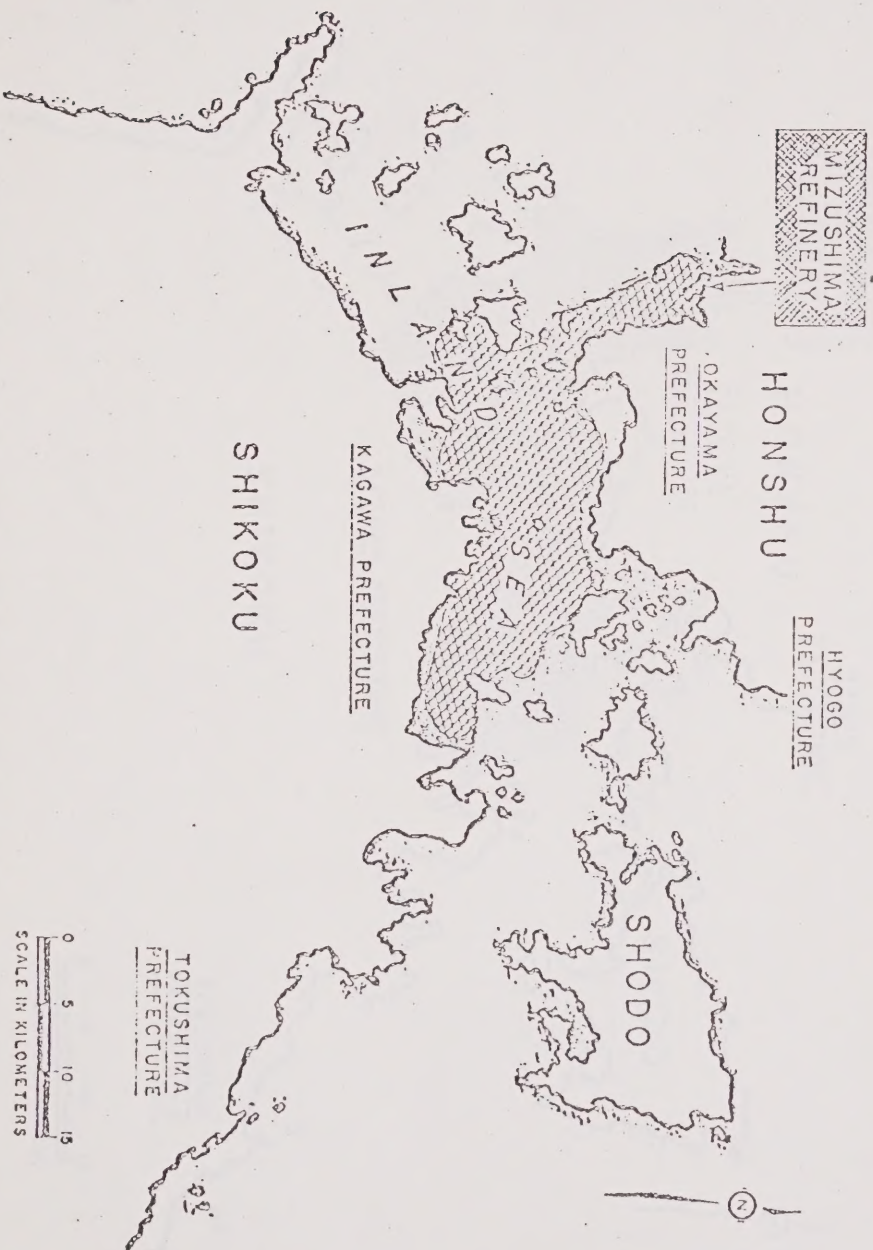
THE INLAND SEA OIL SPILL - DEC. 19th at 0900 Hrs.
Spreading of Oil, Dec. 19th - Dec. 23rd, 1974

Figure 3



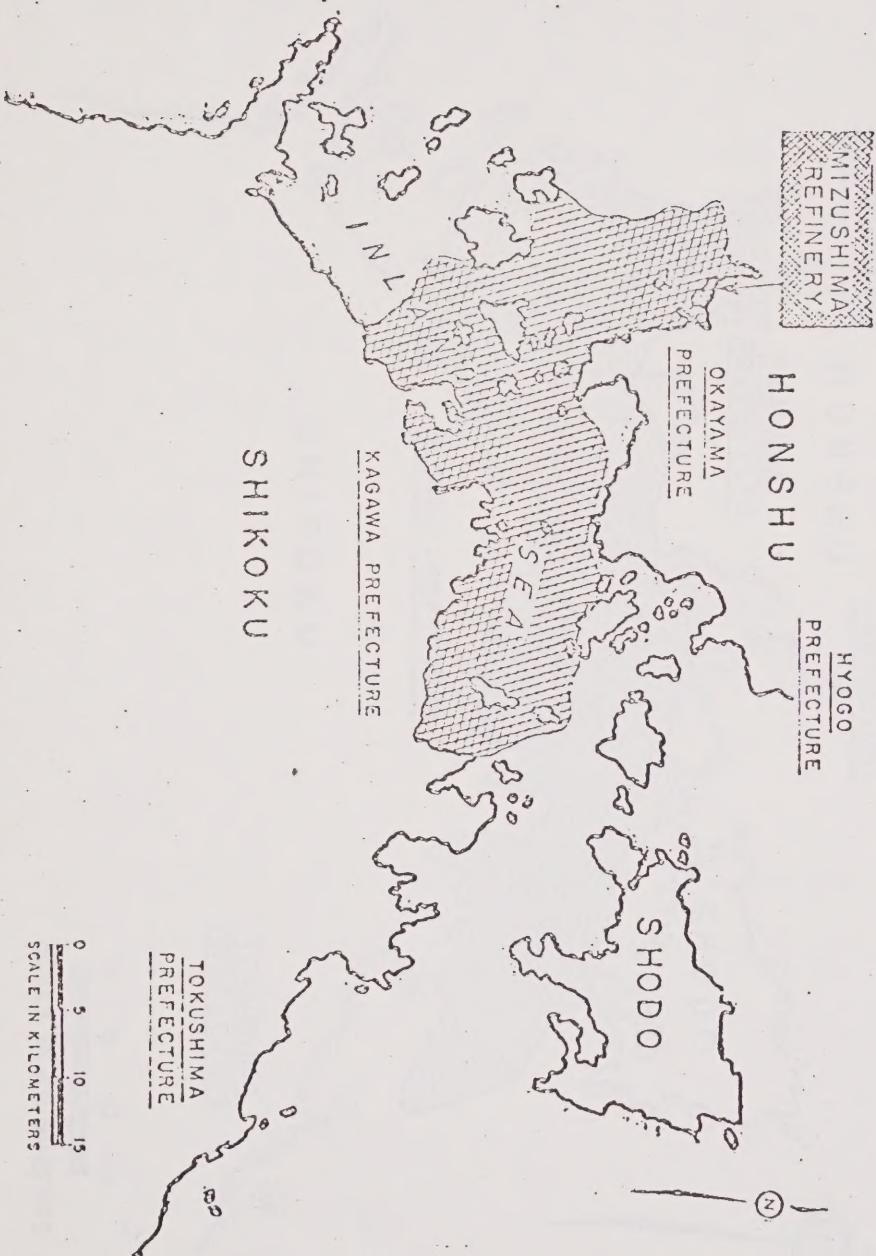
THE INLAND SEA OIL SPILL - DEC. 19th at 1615 Hrs.
Spreading of oil, Dec. 19th - Dec. 23rd, 1974

Figure 4



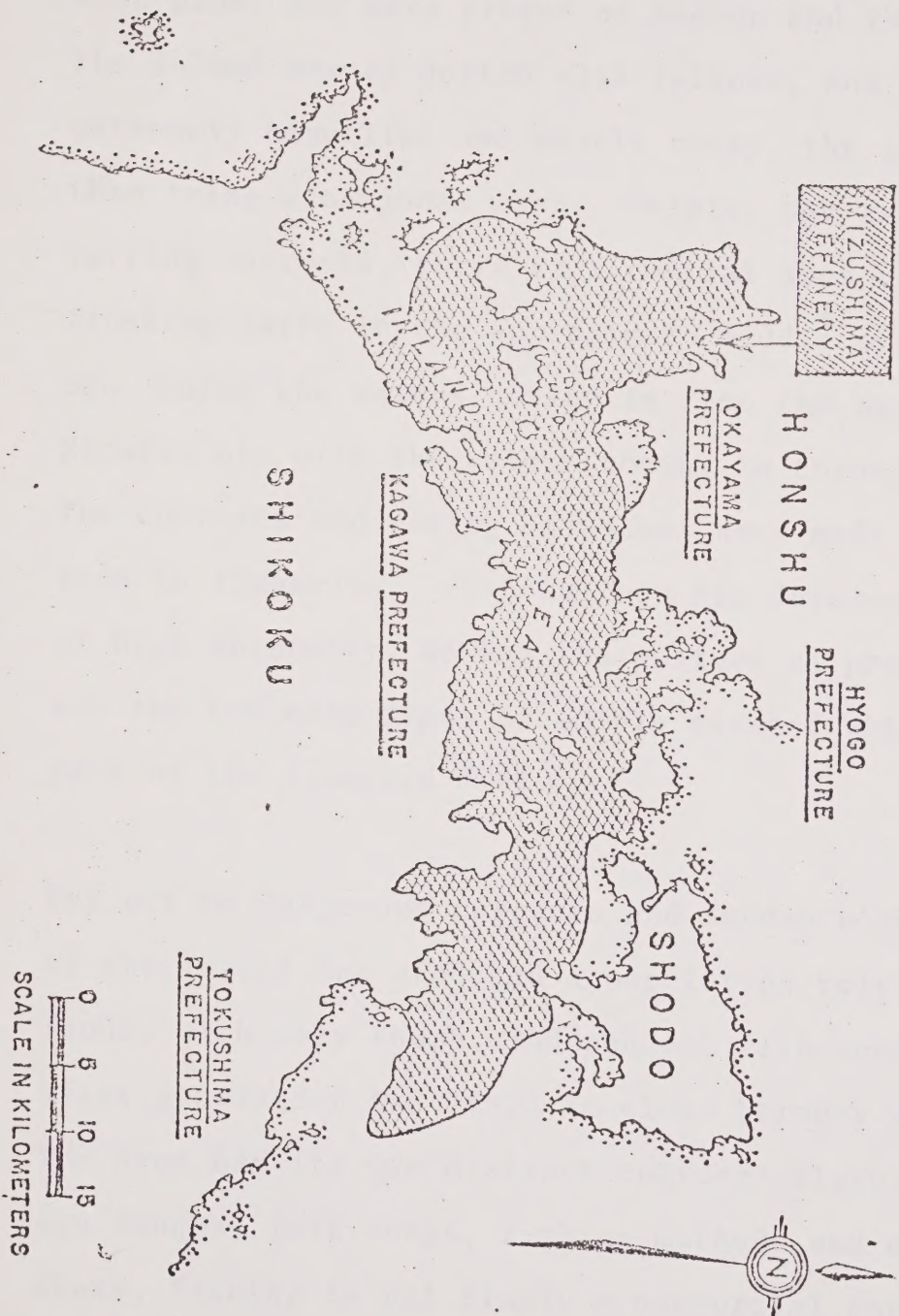
THE INLAND SEA OIL SPILL - DEC. 20th at 0900 Hrs.
Spreading of Oil, Dec. 19th - Dec. 23rd, 1974

Figure 5



THE INLAND SEA OIL SPILL - DEC. 20th at 1345 Hrs.
Spreading of Oil, Dec. 19th - Dec. 23rd, 1974

Figure 6



THE INLAND SEA OIL SPILL - DEC. 21st at 1420 Hrs.
Spreading of Oil, Dec. 19th - 23rd, 1974

The Inland Sea, or Seto Naikai, is a body of water hemmed by the main islands of Honshu, Shikoku and Kyushu, and opening into the Philippine Sea through the Bungo Straits and the Kii Straits, and into the Japan Sea through the narrower Kanmon Straits. The sea area is roughly 7,000 square miles, with an extremely rugged and mountainous coastline, forested with pine, and with groves of bamboo and the finest oranges. The Inland Sea is dotted with islands, and these are extremely beautiful and mostly rocky, the greater number of them being a national park. Despite the tremendous and varying currents, there is a central area of rather low flushing rates in the approximate middle of the Inland Sea, where the waters coming in from the Bungo and Kanmon Straits mix with the waters coming in through the Kii Straits. The currents and mixing of waters have made the area extremely rich in fisheries. Fish culture has developed to a level of high intensity, as has the culture of prawns, oysters, and the two main types of edible seaweed which form a major part of the Japanese diet.

Subject to dangerous currents and sudden winds, the area of the Inland Sea produced a population relying on sea foods, with very tough, independent fishermen, who generation after generation had lived in close harmony with the sea. The area has its own distinct cultural flavor, with its own dances, folk songs, fishing methods and customs. In short, fishing is not simply a commercial enterprise, but a way of life. In the early part of this century, when Japan began to be a great naval power, the Inland Sea

also developed as a centre for other marine activities, being an ideal anchorage for large fleets of vessels. Currently, eight large oil tankers and about 1,800 freighters, barges and ferries ply the inland passages each day. The concentration of shipping and industry in the area has brought with it the inevitable ecological threats of pollution and landfill.

In the past twenty years, and more particularly in the last five years, government and industry have been responding to the mounting pressure of public opinion, and cooperating to clean up the Inland Sea. From local reports, it would seem that the waters and beaches of the area had been at their cleanest for a long, long time, and that Japanese people had begun to see glimmerings of hope for its ecological survival.

During the months of December and January, the prevailing winds are generally north to north west, sometimes west, and surface temperatures vary from 3 to 10 degrees C., depending on the weather and the degree of surface mixing. (It might be noted here that the point of fluidity of the spilled oil was 12.5 degrees C.)

At this time of the year the population of water birds seems rather sparse, comprised mostly of Black headed and Slaty backed gulls, and rather few ducks.

NOTES ON THE MOVEMENT OF THE OIL

Northwesterly and westerly winds carried the oil along the

southern coast of Honshu, severely polluting the beaches and shore installations of Okayama and Hyogo prefectures. Winds during those first days of December 18 to 25 reached the 20 metre per second mark (45 mph) and the oil spread out in long, broad striations across the Inland Sea to the northern coast of Shikoku, touching the eastern beaches of Ehime prefecture and severely polluting the shores of Kagawa prefecture, and finally the beaches of Tokushima prefecture.

Dramatic pictures appeared in the international press of oil being swirled around in the famous whirlpool of Naruto, between the coasts of Tokushima and the big island of Awaji in the mouth of the Kii Straits. By January 7, 1975, an unspecified amount, referred to as "a lot" by some authorities had gone out into the open ocean.

In the first and second weeks of January, oil was pushed into the harbors and bays of northern Shikoku (Kagawa and Tokushima prefectures) and accumulated in depths of 10 to 25 cms.

The islands between the prefectures of Okayama and Hyogo on the main island of Honshu, and the prefectures of Kagawa and Tokushima were all seriously polluted, as were the southern beaches and shores of Awaji island. In all, 469 kms. of coastline were polluted by the Mizushima oil.

The general appearance of the oil on the water was of striations, up to three kilometres long, with heavy cores of thick oil and with much wider and thinner edges. However,

the nature of the oil was soon changed by the low temperatures and by the physical action of waves and currents. The Bunker C that came from the refinery was blackish in color, while the muck that was moving on the sea, on the shores, bays, harbors and channels of Kagawa and Tokushima had, by January 10, become a thick, reddish-brown sludge, referred to in oil spill literature as 'chocolate mousse'. The Japanese fishermen had a far more prosaic and accurate, if vulgar, description for it.

I arrived on scene on January 8. On January 11, I observed massive amounts of this oily sludge in Tokushima prefecture, fifty, sixty and seventy miles from the spill site. Some of the sludge was reaching the point of negative buoyancy and was beginning to sink, slowly. I saw, along several rocky shore lines, big blobs of sludge that would sink, stay under water for several seconds, then slowly come to the surface again. An unknown amount of sludge eventually sank to the bottom at several places in the Inland Sea. This fact has raised some controversy between the various agencies of the Japanese government who took part in the investigations which formed a basis of the long report on the environmental influences of the Mizushima spill, and various private research groups and fishermen. Fishermen and many private or university researchers claim that considerable amounts of sludge sank to the bottom. The government report and the oil company denies this. In personal discussion with Prof. T. Okaichi of Kagawa University, who was one of the members of the 'General Examining Committee' of the official government report, I found that he and his assistants were also of the opinion that a lot of

oily sludge had sunk to the bottom, mainly in shallow waters close to shore. There was therefore controversy within the agencies taking part in the formulation of the government report.

In January of 1975, Mitsubishi Oil Company engineers told me that the sludge or mousse was an 'oil in water' emulsion, approximately 30% oil and 70% water, with a considerable amount of fibres and other debris to bind it all together.

Some beaches and shores were hit by oil two and more times. Each oil polluted island developed twin 'tails' of slicks on the leeward sides, as wind and waves carried oil off their beaches. Not only were the windward sides of islands polluted, for waves and currents tended to 'wrap' the oil around on the leeward beaches. Oil became trapped in the fixed nets of the mariculturists, and this oil was also being continually released by wave and current action.

On January 11, helicopters chartered by the Mitsubishi Oil Company spotted narrow, three kilometre long slicks of oily sludge along the Tokushima coast, apparently being kept about five hundred metres off the shore by currents and by 'echoing' waves. Much of this oil was heading and accumulating into Hude Bay, while other portions were going out to sea.

Tides also carried the oil 600 metres and more up into some rivers. Looking at charts on the walls of various operations centres, one got the impression that the Inland Seas was being attacked by long serpents, as slicks, spotted and photographed from the air, were marked in long streaks

of red on the charts. Indeed, the Japanese coined the phrase 'oil attack'.

Many miles of rocky shoreline, jetties and beaches were covered with the oil that rose and fell with tides and adhered in three or four foot bands.

On beaches, the oil penetrated thirty and more centimetres into the sand. The storms that persisted during the first weeks of clean-up operations deposited sand over one layer of soil, after which more oil was carried in, to be again covered by more sand. Core samples from beaches in Kagawa and Okayama prefectures looked like a layer cake.

In early January, in the whirlpools of Naruto, some oil was recorded as going into emulsion in the water at a concentration of 0.6 ppm. Other samples in Kagawa and Tokushima indicated concentrations of 0.95 ppm. The Japanese press reported that emulsified oil was found to a depth of five metres. It is to be noted that the Japanese government's Fisheries Agency considers that a concentration of 0.01 ppm of oil in water will taint oysters and fish if exposed for 24 hours, and that concentrations of 0.2 ppm in mud for one hour will taint clams etc. Therefore, due to the preliminary findings of oil in the water, and due to the very extensive surface and shoreline pollution, all fishing activities and fish marketing in the affected areas were closed by the Japanese government. This involved about half the total area of the Inland Sea. A comprehensive picture of the behavior and movement of the oil would fill many more pages than the nature of this discussion warrants.

The Mizushima Oil spill is certainly the most intensively studied and controversial spill since the accident of the 'Torrey Canyon' in the English Channel. In 1975, the Japanese government, under the leadership of their Environmental Agency, put together a wordy, 162 page report entitled "Investigations Into the Environmental Influences of the Mizushima Oil Spill."

This report is the result of studies by several agencies, the total cost being some \$Can. 407,000 (Yen 116,264,000). It indicates that water quality in the Inland Sea returned to its previous levels within months of the incident, and a superficial reading of the report would tend to minimize the effects of the spill in the water column. However, this report has released a storm of protest from the press, from Fishermen's Cooperatives, and from university research workers.

Professor Okaichi, of Kagawa University, one of the members of the investigative board, claimed that the government's investigation was unscientific. He said that the sampling was done on a grid system, which ignored or missed actual locations of heavy pollution. Fishermen said exactly the same thing, although their position was a very delicate one, for the simple reason that if the public believed the fish taken from the area to be contaminated, they would not be sold. Professor Okaichi and others pointed to poor liaison between investigating departments.

I personally talked with more than a hundred individuals in the Inland Sea, and it would seem to me that the

ecosystem or life regimes of the area are changing, and that the oil spill may have accelerated these changes.

However, it would be impossible to state this as fact.

Certain fish, usually expensive ones like sea bream, seem to be decreasing in areas where fishing has not been excessive but where the oil pollution had been serious. Certain coarse fish, plankton eaters of the anchovy family, have increased. (These fish are used only as fertilizer). The oil in dispersion or emulsion seems to have seriously reduced the number of sea urchins. The populations of a swimming crab (*Tritodynamia Horvathii*) has exploded, in such numbers as to clog the engine intakes of ferry boats.

Professor Okaichi believes that oil spills may very well be the cause of increased incidence of 'red tide'. He says that during the first period of a spill planktonic diatoms and flagellates dropped dramatically in numbers in the oil-affected surface waters. Water which would be expected to have 1000 cells per c.c. had only one or two cells per c.c.

Later, when oil levels in the water dropped to 0.1 ppm and less, diatoms and dinoflagellates bloomed, in places causing the 'red tide' which kills other marine life.

The immediate effects of the spill were obvious. The waters of the Inland Sea are used intensively for fishing and for mariculture of various types. The area is particularly renowned for the culture of edible seaweeds, of two main types:

'NORI' - laver, (*Poryphyra*), a seaweed that is part of the daily diet of almost every Japanese. It is cultured on nets that are suspended in a flat, horizontal plane just below the surface of the water. The nets are 'seeded' with monospores that are collected on oyster shells, and then are set fairly close into shore in large banks of buoyed nets. 'Nori' has a very delicate flavor, and the flavor greatly affects the market price.

'WAKAME' - (*Undaria pinnatifida*), a seaweed that is commonly used in Japanese soups and other dishes, and which is also cultured on nets.

The edible seaweed industry was seriously affected in Okayama and Hyogo prefectures, and in Kagawa and Tokushima prefectures the effect of the spill was catastrophic. The growing season for this type of seaweed culture is October to March. In spring, the laver plants die.

The spill destroyed one year's crop of seaweed in the affected areas. In Kagawa and Tokushima prefectures, the 1975 crop was less than ten percent of what it should have been, and in Kagawa prefecture alone, 110,000 of the 120,000 'nori' nets were so covered with oil as to render the nets useless. The 1975 government report gave the figure of 240,749 sets of nets being destroyed by oil.

Marine culture of fish was also seriously affected in the area, especially the coastal fish culture stations of Kagawa and Tokushima. The oil was pushed into bays by wind and current, and the most immediate effect on the fish farms -

which are usually net enclosed compounds open to the sea - was that a thick surface covering of oil prevented the distribution of feed. Oil clogged the nets and fractions of it dissolved in the water.

The principal types of fish cultured in the area are yellowtail ('hamachi' - *Seriola quinqueradiata*) which are marketed in three year classes, under three different names, the porgy or red snapper ('madai' - *Chrysophrys major*, family Sparidae), and the black sea bream ('kurodai' - *Mylio macrocephalus*). In Kagawa and Tokushima, this industry was severely damaged. Members of the fishing cooperatives reported that more than 30,000 fish had been killed. In areas I visited, fishermen reported that fish were starving in the compounds. The Asahi newspaper, the Mainichi newspaper and several weekly magazines carried pictures of dead and oil-smeared yellowtail. Fish that were neither starved nor poisoned by the oil spill were never-the-less unmarketable. The main food species affected by the spill were: mussels, oysters, short-necked clams, sea bass, black sea bream, red snapper, yellowtail, whelks, octopus and 'hiiragi' (*Leiognathus nuchalis*). The national and local news carried many reports of concentrations of oil in water, as much as 0.95 ppm, however, the conditions of waves, currents and mixing seemed to be so variable, that the picture is quite confusing in the first weeks of the spill. Certainly, the over-all survey data records lower levels of oil in the water column.

Whatever research results may prove, disprove or question,

the Japanese government closed all marine fish markets in the affected area, which was almost half of the Inland Sea, and no fishing vessels harvested. Fish bait sellers were closed down and no products of mariculture were sold. Despite the rising Japanese per capita consumption of land-animal products, it is still a basic truth that marine products form a very important part of the Japanese diet, especially of the people outside the mammoth cities like Tokyo or Osaka. In the polluted area of the Inland Sea, common items of diet like the short-necked clams disappeared from the markets. This affected many people, as this food was relatively cheap and used by all strata of the Japanese society.

By the end of January, many intertidal areas had been oil covered for more than three weeks. Oil was deposited on sandy beaches in successive waves, making oil-sand 'layer-cake'. In November 1975, when I revisited some of these beaches, I found many dead clams in the sand. Local people were still not eating the clams, claiming that when put in water an oil film would appear on the surface of the pot, and that the clams were unpallatable. However, researchers reported verbally to me that small clams were numerous, and suggested that due to the oily tast of the spawning adults, the adults had not been taken, thus leaving more to spawn.

In January of 1975, on my first trip to the beaches, I had observed oil penetrating to a depth of 20 cms. In November of 1975, in the same location, I found no oil at that depth. Later, talking to fishermen digging bait,

they assured me that the oil was now at 40 cms. and deeper.

Certainly, in November, eleven months after the spill, fishermen were digging and catching polychaetes (worms) for bait. They were also digging for a small octopus which lives in the mud and which is used for human food. They claimed that the numbers were 'far fewer' than before the spill, but I am aware of no research evidence to back this up; mainly because no population studies were done prior to the spill.

If I may be forgiven a personal comment, it would seem that despite the enormous amount of effort and research put into determining the environmental effects of this spill, the picture becomes even less clear, more confusing. Extremists on both sides may take data and extrapolate whatever they wish to from it. One said that the oil spill was the beginning of the death of the Inland Sea, some said that the oil spill had no effect at all. Obviously, neither side is correct. The tragedy is that the rift becomes wider. The fishermen and residents, people who have tasted (or imagined) oil in their sea food, and who have noticed but not scientifically recorded changes in their environment, have become increasingly distrustful of government and industry. As an impartial observer, with no loyalties to either side, I was able to observe this conflict and distrust.

I believe that this distrust and conflict could become rife in Canada too.

To return to the subject of environmental effects: there were practically no accounts of oiled birds. From the Japanese government's Environmental Protection Agency, I heard of only one duck which was found dead with oil in its gut. The cleanup efforts were so intensive that north-bound migratory birds, appearing in the Inland Sea in early spring, were not affected. The press carried reports of one porpoise, dying in the slicks.

In November, previously oiled walls had been recolonized by periwinkles, and barnacles were living except on those walls which had been cleaned by high pressure steam or by flame. Regrowth of algae (green algae) was sparse, but evident. Crabs were flourishing in crevices previously badly oiled. However, fish previously caught in shallow waters close to shore now had to be netted further out.

I would say that the massive clean-up effort of the Japanese industry and government was effective in minimizing the long-term effects of the oil, but that these long-term effects cannot be brushed aside or forgotten.

NOTES ON STUDIES OF THE SPILL AND ITS EFFECTS

On January 27, 1975, it was announced that the Japanese government would launch a joint ministerial survey in early February to investigate the degree of sea pollution caused by the Mizushima spill. The survey was spearheaded by the Environmental Agency, with the Maritime Safety Agency, The Fisheries Agency, the Ministry of Health and Welfare, and the Ministry of Construction participating. The

survey covers water and bottom analysis, a market inspection of marine products, a long-term investigation to examine the possibility of effects on humans from hydrocarbons taken into the system from oil contaminated marine foods, the degeneration or bio-degradation of oil by bacteria etc., and the movement and spreading of oil both on and below the water surface. The studies cost about \$407,000 Canadian dollars.

The Environmental Protection Service saw fit to allow me to have this weighty report translated, and I am in the process of editing the English and retyping it.

NOTES ON THE CLEAN-UP OPERATIONS

Press reports in Canada and the U.S.A. carried accounts of a 'leak' of oil from the Mizushima refinery. This was a poor choice of words; 'gush' or 'flood' would be more accurate. Before any criticism of the way the spill was handled can be made, it must be understood that the oil came out at great force, and was hot enough to scald. This made containment extremely difficult. The oil got into the canal leading to a separator system, and had it been a much smaller amount, it would have been contained there. However, the oil overflowed the separator and entered Mizushima harbor. Booms were placed, but winds were strong, the water surface choppy, with tidal currents of 1.5 knots experienced in some places. It was also dark. I sincerely believe that no criticism can be fairly aimed at the initial efforts of control. The foremost concern in the minds of the refinery crew was that of fire. Hot oil had surrounded

several other tanks, and had covered a total land area in the refinery of 148,300 square meters, so that the danger of fire and explosion was very real. As it was, the 34 ton base of the vertical ladder by the side of tank 270 was moved by the force of the escaping oil a distance of several yards so that it is smashed through the dike. Tank 270 itself was buckled and ripped.

An item worthy of note is that during these operations, both the initial period and the months following, nobody was killed or injured by the accident or the clean-up operations, and this, I feel, is an exceptional mark of the competence of the Japanese on-scene commanders, both from industry and from the various governmental agencies.

The principal types of boom used in oil containment were a Bridgestone ocean type boom (designated as Type "B" by the Enforcement Regulations of the Marine Pollution Law) and a Yasunaga harbor type boom (designated as Type "A" by the same regulations). The ocean boom has a 40 cm. skirt and a float-supported emergent part 30 cms. high. Japanese Ministry of Transport ordinances regulate the length of the boom sections, depth of skirt, height above sea surface, tensile strength and the type of fastenings of booms used in port areas and by ships in Japanese waters.

While I was travelling the coast of Shikoku I saw a few non-regulation booms which were mainly owned by fishermen's cooperatives. The Mitsubishi Oil Company, and of course the Maritime Safety Agency used regulation type booms.

In all, 25,870 meters of boom were actually used.

The booming of Mizushima harbor was not effective. The accident occurred at night on December 18, 1974, and by 0900 hours on December 19 the oil was well outside the harbor and into the Inland Sea.

After the initial failure of booming operations, the Maritime Safety Agency attempted to emulsify the oil by spraying chemicals from 41 patrol vessels. The chemicals were inducted into high pressure hoses. This was not effective because:

- a) the volume and thickness of the oil would require huge amounts of chemicals and enormous mixing powers,
- b) the temperature of the water and the wintry conditions made the Bunker C oil extremely viscous.

Fishermen reported that the dispersed oil was in places coming out of emulsion again.

Within a few days of the initiation of clean-up operations, the use of chemical dispersants on oil on the surface of the sea was stopped due to strong protests from fishermen's cooperatives in all four of the badly affected prefectures. In certain incidents (as related to me by the fishermen involved), the fishermen actually went out to vessels spraying chemicals and stopped them from doing it.

However, despite this, some 1,014,733 litres of dispersant were used (223,216 gal. Imp.).

23

In Japan there is currently a very strong feeling, both in fishing and scientific communities, against the use of chemicals to handle oil spills, and this feeling was reflected in numerous newspaper, radio and television reports.

Fishermen in the Inland Sea were absolutely adamant in their refusal to accept dispersants, maintaining that the dispersed oil was all the more easily available to ocean plankton, and that it was ingested by the plankton and then by fish with the result that fish were tainted. Dispersants were very definitely out of favor in the Inland Sea clean-up. Due to the division of command and the large area of operations, it was difficult during the first month or so to get accurate figures on the quantity of equipment used, numbers of boats and trucks etc. employed, and the numbers of personnel mobilized to cope with the spill. However, during the first month, the Sixth Regional Maritime Safety Board announced that the following resources had been utilized.

8,189 workers

738 vessels

153 aircraft

30,000 metres of boom (this boom had been purchased, but not all in fact was used.)

Cost of fuel alone for that month was \$83,333.

The Maritime Safety Agency, several refineries and port authorities all had vessels in the Inland Sea, and many fishing boats were also used. During the cleanup operations of the first weeks oil was trapped in booms and recovered by various systems; floating pumps, rollers and hand bailers. Absorbent roller recovery systems were used but had a bad

reputation with the oil companies and with the Maritime Safety Agency. Canadian style 'slick-lickers' were used to good effect, but the capacity of holding tanks and disposal of recovered oil posed problems, as did mechanical failure due to the weight and thickness of the oil slicks in harbors.

Absorbants were supplied by the Mitsubishi Petro Chemical Company. The principal type used was a 50 by 50 by 0.5 cm. sheet absorbent called 'Attack Ace'. This material looked like thick white cloth and seemed effective, but was not re-usable. Unfortunately in many instances it was used wastefully and indiscriminately, and a lot of it got loose in the sea and drifted around, and according to fishermen, a lot sank to the bottom.

As the oil spread, the Mitsubishi Oil Company (MOC) used dozens of trucks to distribute booms and absorbents for the use of local authorities and fishermen's cooperatives. Equipment and personnel were brought in from all over Japan. MOC pulled every available man from branch offices and laboratories all over the country.

MOC's first operations centre was in the Mizushima refinery. Normal refinery operations were closed down, and remained so for the duration of clean-up and of the investigations. The refinery did not start operating until August of 1975, eight months after the accident.

Of the Japanese government departments, the Maritime Safety

was certainly the most active and effective. They set up local operations centres, as well as an operations centre in the Ministry of Transport's offices in Tokyo. The Maritime Safety Agency took responsibility for all marine operations, coordinating and controlling the movements of the oil recovery fleet and of the oil spotting vessels and aircraft.

The Fisheries Agency of the Ministry of Agriculture was also immediately effective. Each prefectural government office in the four prefectures badly hit by oil set up operations centres, and research centres. In the Inland Sea began impact studies. A certain amount of clean-up was coordinated through the prefectural offices and the Fisheries Agency as well as through local fire and public health departments.

I visited the Fishery Agency's operations centre in Tokyo, and was told that the agency had the following main objectives in mind;

- a) Arrange for compensation for the affected fishermen as soon as possible so that they would have enough money to live on.
- b) Coordinate the removal and recovery of oil.
- c) Encourage and conduct research into the long-term or side effects of the accident on the marine environment.
- d) Encourage and direct the reconstruction of the destroyed fishing grounds and mariculture areas.

As of January 6, 1975, the Fisheries Agency were still

analyzing damage reports to fisheries and connected industries, and had to that date come to a figure of \$31,333,333. damage. On January 22, 1975, the Fisheries Agency was reported by the Canadian press to have given a damage figure of fifty three million dollars. When I was in Kagawa and Tokushima, analysis of damage reports was still being carried out, and claims from fishermen, bait sellers, logging companies etc. were still coming in.

In August, through the help of the Canadian Embassy in Tokyo, we got hold of the following figures.

To August of 1975, the Mitsubishi Oil Company advised that they had paid the following sums to this date:

1) Damages to fishermen, fish markets, hotels, storage houses etc.

17 billion yen.

2) Payment for oil recovery and cleaning works of fishermen and other people excluding government and military services.

13 billion yen.

3) Loss from refinery operation shut down for eight months.

17 billion yen.

4) Cost of fuels, booms, dispersants, etc. used by MOC

Not figured yet.

Other damage negotiations were still underway at this time, and complicated court cases were sure to be initiated to settle responsibility for the cause of the accident.

The Maritime Safety Agency advised that they had requested and received 46.8 million yen from MOC to cover the expenses

which they incurred during the cleanup operations, namely: overtime of government employees, fuels for ships, booms, dispersants etc. Their participation was done in the context of the Ocean Contamination Prevention Law. Article 41 of the same requires the party responsible for an oil spill to pay the expenses of oil recovery and cleaning measures which the Director-General of the Maritime Safety Agency initiates and pursues at his own discretion.

The Kagawa Prefectural Government advised that:

- 1) Mitsubishi paid 15,060,000 yen to Kagawa prefecture to cover overtime of prefectural employees, cost of booms, dispersants, absorbents, fuels etc.
- 2) Mitsubishi paid 15,679,120 to local municipalities in Kagawa prefecture to cover overtime of their employees, and 111,586,719 yen to cover costs of material and fuels used in the recovery operations.

Okayama and Tokyshima prefectures also received money from MOC, but smaller amounts.

Neither the Fishery Agency nor the Ministry of International Trade and Industry requested payment from MOC, the reason being that the Ocean Contamination Prevention Act is under the administration of the Maritime Safety Agency.

From figures available to date then, the cost of compensation, expenses and loss from operational shutdown is approximately 48 billion yen or 160 million dollars.

These figures are not complete.

In the official government report "General Investigation into the Environmental Influences of the Mizushima Oil Spill of 1974" the following figures were quoted.

Oil and water collected from the sea.....	7,430 kilo litres.
45 gallon drums filled with oil and water by shore parties....	
	102,885 drums
Polluted sand and shingle removed from beaches.....	
	5,720 tons.
Sets of nets destroyed.....	240,749 sets.
Number of people taking part in cleanup...232,150	
Ships and boats used.....	38,653
Aircraft used.....	344
Boom used in operations.....	25,870 metres.
Dispersants used.....	1,014,733 litres
Absorbents used.....	830,116 kgs.

The figures are both confusing, and staggering, and for me it is horrifying to think that the contents of one storage tank could cause such damage and expense.

The Environmental Protection Agency, Water Pollution Control Board, also had an operations centre in Tokyo and were performing a coordinating function. The EPA is a relatively new body, incorporating personnel and expertise from several other agencies. Their concern is mainly long-term abatement of water pollution. They are not a heavily-staffed organization, and their input into the Mizushima spill clean-up did not appear to be particularly dynamic.

Towards the second week of January, a ministerial or

'sub-cabinet' National Operations Centre was formed in Tokyo, together with a parliamentary audit committee.

(This spill was to see the birth of dozens of committees of various functions and levels).

The Mitsubishi Oil Company itself was intensely involved in clean-up and recovery. They coordinated the supply of materials as well as the hiring and movement and the organization of cranes, trucks, vacuum trucks, pumps, barges and boats. They chartered aircraft to plot the movement of oil. Their staff worked through the holiday season, putting in extremely long hours, every day.

When I arrived in Japan on the first study trip (Jan. 6, 1975), operations had already peaked in Okayama and Hyogo prefectures, and were just passing the peak at Kagawa prefecture, with work and activity building to a peak by the second week in January at Tokushima. MOC was shifting men and equipment as needed, and working out of three main operations centres.

I spent five days working out of the Kagawa prefecture operations centre in Takamatsu city. My decision to centre there was based on the following points:

- a) All types and phases of recovery and clean-up were being coordinated there.
- b) This operations centre had at that time the greatest concentration of skilled and technical MOC personnel.
- c) Having passed the peak of operations, things at the centre were well organized and less frantic than they had

one or two weeks previously, and I felt that my presence and questions would no longer seriously interfere with the work.

At the Takamatsu city operations centre, which was situated in a modern hotel, and practically occupied the entire hotel, some 69 people were working from early in the morning until late at night, every day. The Plaza Hotel, Takamatsu, was very conveniently situated, close to the harbor and ferry terminals. Almost every room in the hotel was rented by MOC, and they used two large meeting rooms for their operations. One was principally a communications and administration room, complete with a xerox, a telecopier, half a dozen phone lines, tables, blackboards and charts. The second large room was on the ground floor, and was a dispatch headquarters for the men going out to supervise operations in the field. In the second room you could wear dirty boots, while in the first you couldn't without making the hotel staff very cross. It seemed to be a very well-functioning system.

Meals, taxis etc. were arranged by MOC, and taxis were paid for by signed 'chits' which all the taxi companies honored without question. They were marked as to their origin for easier accounting.

While working in the centre at Takamatsu, I was privileged to get a feeling for the teamwork at which the Japanese are particularly good.

On January 8, 1975, in Kagawa prefecture alone, the following equipment was being used.

8,000 metres of boom

15,000 empty 45 gallon drums

19 Marine Safety Agency patrol vessels

56 oil recovery ships

6 barges

1 crane ship

1 oil incinerating ship

Varying numbers (10 to 30) trucks and vacuum trucks were in use. Apart from the booms supplied by MOC, the fishermen's cooperatives had their own harbor booms.

By this time, having been carried across the Inland Sea, the oil was a heavy sludge. The workers found that slick-lickers, floating pumps and other specific oil recovery gear was not as effective as removal of the oil by long-handled bailers. It was found that one person could fill a 45 gallon drum in twenty minutes this way. At every harbor and fishing port fishermen and their families bailed oil into drums that were carried away by trucks or barges. It sounds primitive, but it was effective, with minimal equipment costs, and with the kind of manpower available in Japan, it was an excellent solution to the problem.

An example of the amount of oil removed by local fishing families is that of the tiny harbor of Shimo Kasai, where 120 drums a day were taken for one week - 840 drums, by hand bailing. Most of this was oil, with very little

water. The trucks and barges could not keep up with the amount of oil being taken this way. In Shimo Kasai harbor, the oil was so thick on the water that the outboard engines were being stopped by it. There were harbors like this in all four of the badly affected prefectures.

Vacuum pumps were also found to be effective, either ship-based pumps or ordinary vacuum pump trucks (of which there are many in Japan, used in place of their woefully inadequate sewage systems). In many cases it was possible to drive the truck to the edge of a dock or a jetty wall, and to hold the nozzle of the pump in the oil by hand and suck it up.

At sea, the oil was trapped in booms, concentrated into a small area, and then pumped or bailed into tanks and drums. The amount of sludge/oil/water/debris recovered was prodigious. By January 13, 1975, in Kagawa prefecture alone, 13,500,000 gallons of oil and muck had been collected, and by no means were operations in that area finished. The recovered oil etc. was taken to a prefectural site near Banosu refinery, Kagawa. Bulldozers dug pits 1.5 metres deep, and laborers lined the pits with plastic sheeting and build a 40 cm. berm around them. The filled drums were emptied into these pits. This was a temporary arrangement. The whole problem of disposal was one which took immense effort. Eventually, the oil and water etc. were taken to the Mizushima refinery, to be recycled at great cost. At the Banosu site, I saw an accumulation of 10,000 drums, filled in three days.

There were three main gathering sites set up to handle the recovered oil; one at the refinery in Mizushima, one at Banosu for Kagawa prefecture, and one at Kameura for Tokushima prefecture. At the Tokushima prefectural site, I saw an accumulation of 13,500 full drums.

These figures are confusing, but the important fact to be well remembered in preparing for an oil spill is that if you spill one gallon of crude oil or Bunker C, you are going to recover at least five gallons of oil/sludge/water/debris.

The two most heavily utilized pieces of equipment in this whole operation were the long handled bailer and empty 45 gallon drum.

Another piece of simple equipment which MOC found to be particularly good for picking up sludge was a two metre square of steel mesh, the mesh being 5 mm., and the ends turned up to form a shallow basket. This mesh basket was manipulated by a crane, either land or ship based. It was dipped under the oil sludge and lifted out. The free water runs out and the sludge is dumped.

Men of the Japanese Self Defence Forces worked in three and sometimes four teams on land operations. A total of 900 officers and men were employed in oil recovery and beach clean-up. They used their own jeeps, trucks and portable radio equipment, and they controlled traffic on the narrow country roads in their particular areas of

The energy and efficiency of these military operations teams was most impressive.

Beaches were cleaned with heavy and medium heavy equipment where possible, but in most instances the job had to be done by hand. Dirtied sand was removed. Oiled rocks were wiped with 'Attack Ace' absorbent. No peat moss or straw was used. Jetty walls were cleaned with steam, with high pressure hoses, and in places, with chemicals or with flame.

On January 11, I visited Tokushima prefecture. MOC had set up its operations centre in the Park Hotel, Tokushima city. They had installed a xerox, a telecopier and several phones. On that particular day, the following equipment was in use (in Tokushima).

Trucks - 30

Vacuum trucks - 10

Oil recovery ships - 2

Crane ship - 1

Maritime Safety Patrol vessels - 5

Smaller fishing vessels - 30

Oil booms - 10,000 metres.

In Tokushima prefecture, four operations centres were working; the MOC centre in Tokushima city, a Maritime Safety Agency centre at Komatsu island, a prefectural centre at Fukuchiji and a city government centre at Naruto city, which had been badly hit by the oil. MOC had established a huge collecting base and equipment and supplies stockpile.

In the second week of January, oil was still moving and collecting in bays along the coast of Shikoku, especially in Hude Bay, where it was 5 to 10 cms. thick - a heavy, reddish brown sludge which was being removed by vacuum trucks.

Dr. Okaichi of Kagawa university was using high speed chromatography to 'finger print' oils. In July, samples taken from the port of Sakaide in Kagawa proved to oil from the Mizushima spill. It had probably melted off rocks or jetty walls.

A small but interesting detail of the operations is that all vehicles employed in the clean-up carried placards which enabled them to pass through toll gates freely, and which assured them of special police assistance. In crowded Japan, this must have saved a lot of time.

SUMMARY

Thanks to the cooperation of Japanese government officials both in Tokyo and in the prefectures, and thanks to the cooperation of the Mitsubishi Oil Company, I was able to gather a great deal of information and experience in two short field trips (a total of three weeks). I was also lucky to get a copy of the official Japanese report, which has now been translated (but not yet retyped and edited). Japanese fishermen, scientists and press were also especially helpful. The Mizushima spill has already been the subject of three books in Japan, and other reports are still being compiled.

The spill has cost over \$160,000,000. and the accounting is not yet complete. It caused a lot of social trauma. It demonstrated that despite our advanced technology, we cannot handle large oil spills in areas of wind, wave and current.

WHAT CAN CANADA LEARN FROM THE MIZUSHIMA OIL SPILL?

Different observers would no doubt place different emphasis on what happened. I believe that the Mizushima spill demonstrated the damage, environmental, political and social, that can be caused by escaped oil even when contingency planning and readiness is excellent, and even when equipment and labor is quickly available.

It can be argued that the damage to the Inland Sea was all the more severe because of the intensive mariculture in the area, and that Canada's coasts do not have this kind of intensive use. However, to paraphrase politicians, we must look to the future, and our coasts are being more and more developed for future recreational and food-producing activities. Moreover, the rather small spills which we have experienced in Canada so far have already proven to be extremely expensive to industry and government.

In the case of the Arctic, I fear personally that Canada might follow the example of Chile, and their oil spill from the tanker "Metula". The Chileans decided that the area was too remote and difficult to warrant clean-up of any kind. Certainly clean-up efforts in the Arctic would be

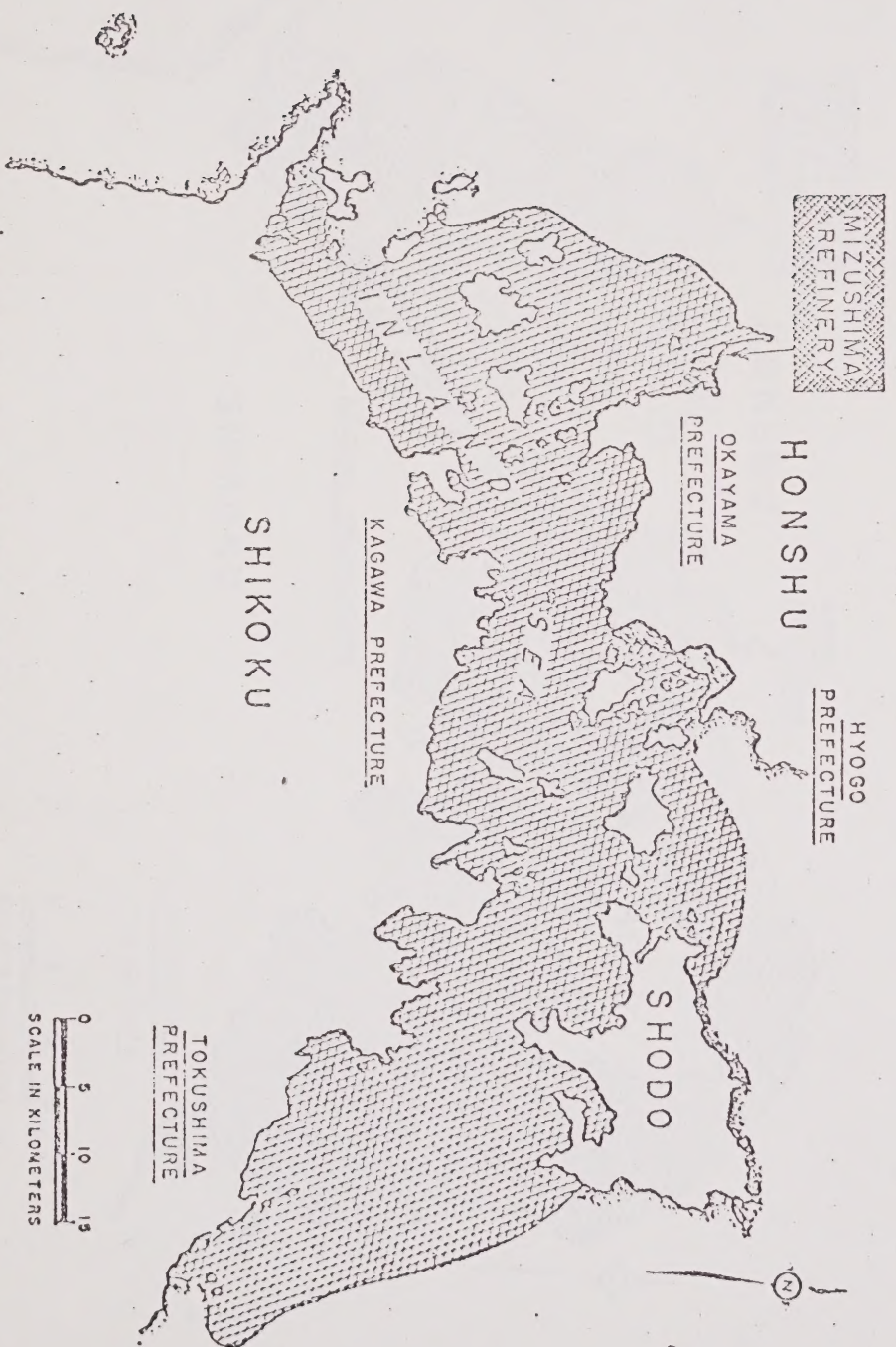
very much more expensive than in Japan.

Japan is a highly industrialized nation, with five times our population in a fraction of the land area. Despite an extremely rugged coastline, access to shores are generally excellent. Labor is readily available, and the Japanese are an energetic and dedicated people. Items of equipment, (like long-handled bailers) can be manufactured in record time, with a minimum of fuss.

In Canada we do not have the labor force nor the amount of equipment that Japan has, yet we have a coast which is much, much longer, just as rugged, and generally much more difficult if not impossible to get access to. I personally question whether government agencies, whether it be federal, provincial or municipal would react in Canada as energetically to the dirty field work as did the Japanese.

Of course, all problems of clean-up and work of any kind are compounded by Arctic conditions.

Finally, it is obvious that oil spills are of international concern, and that international exchange of knowledge, technique and even of materials, is a goal to be earnestly pursued by all maritime nations.



THE INLAND SEA OIL SPILL - DEC. 22nd at 1530 Hrs.
Spreading of Oil, Dec. 19th - Dec. 23rd, 1974

Figure 8

